AMENDMENTS TO THE SPECIFICATION

On page 6, please add the following new line after line 19:

FIG. 10D illustrates further optional transmitter elements that may be incorporated into various embodiments of the invention.

On page 7, please replace the paragraph beginning at line 1 with the following rewritten paragraph:

The CI system of the invention provides for control and programmability of the frequency spectrum of multicarrier and single-carrier signals. CI signal synthesis and analysis (i.e., decomposition) may employ combinations of block transforms and sliding transforms, such as described in [[the]] U.S. ~~patent application~~ Patent Application No. 10/414,663, entitled "Orthogonal Superposition Coding for Direct-Sequence Communications," filed on Apr. 16, 2003, and incorporated by reference herein.

On page 10, please replace the paragraph beginning at line 7 with the following rewritten paragraph:

The over-sampled data is coupled into an optional pulse-shaping filter 204. The pulse-shaping filter 204 performs spectrum shaping of one or more sub-carriers components of the output CI signal. The pulse-shaping filter 204 typically shapes the weights that are input to the bins of the IFFT 206. Other types of Fourier transforms may be used. For example, an IDFT or an I-OFFT may be employed. Other types of invertible transforms may be employed as appropriate for the output signal form, which depends on how a subcarrier is defined. Accordingly, various types of sub-carrier generators may be employed in place of the IFFT 206. Various types of subcarriers and corresponding CI processing relating to wireless

communications are described in [[the]] U.S. Patent Application No. 11/424,176, ~~patent application~~ entitled "Method and Apparatus for Using Multicarrier Interferometry to Enhance Optical Fiber Communications," filed on Nov. 2, 1999, and incorporated by reference herein.

Please replace the two paragraphs beginning at page 11, line 15 with the following two rewritten paragraphs:

A guard interval, such as a time-domain redundant cyclic prefix, is typically inserted between transmitted symbols after inverse Fourier transform processing. In order to simplify frequency-domain equalization, the guard-interval length may be selected such that it exceeds the FIR channel memory. A guard interval may be implemented by padding trailing zeros (i.e., a null signal) to the end of each transmitted symbol, such as described in B. Muquet et. al., "OFDM with Trailing Zeros Versus OFDM with Cyclic Prefix: Links, Comparisons and Application to the HiperLAN/2 System," *IEEE International Conf. on Communications*, New Orleans, LA, June 18-22, 2000, pp. 1049-1053, which is incorporated herein in its entirety.

Various data-detection algorithms may be employed in a CI receiver if a guard interval is not inserted after every symbol, or if it is omitted completely. Such techniques may approximate exact frequency-domain equalization, which eliminates the need for guard intervals. A computationally efficient interference cancellation may be performed. Accordingly, C. V. Sinn, J. Gotze, M. Haardt: "Efficient Data Detection Algorithms in Single- and Multi-Carrier Systems Without the Necessity of a Guard Period", ICASSP 2002, Orlando, 2000, pp. III-2737 to III-2740, is incorporated by reference.

Please replace the paragraph beginning at page 14, line 1 with the following rewritten paragraph:

FIG. 3A illustrates a nearly rectangular spectral response 301 of a CI pulse 311 (shown in FIG. 3D) having ten subcarriers (modulated with random data) compared to the spectral response 302 of a Gaussian-shaped pulse 312 (shown in FIG. 3B) having the same pulse width as the CI pulse 311. The CI pulse 311 and the Gaussian pulse 312 are characterized by a frequency offset (e.g., an IF or carrier frequency) f_0 of 20, wherein the units of frequency are shown in normalized, generic form (and may be shifted to a desired frequency band).

Please replace the four paragraphs beginning at page 15, line 1 with the following four rewritten paragraphs:

It is well known in the art to apply windowing to smooth the transitions between adjacent data symbols, and thus, increase the spectral roll off. The following cyclic prefix shaping technique is well known and described in Chapter 2 of R. Van Nee and R. Prasad (OFDM for Wireless Multimedia Communications, Norwood, MA: Artech House, 2000, pp. 33-52). A cyclic prefix and postfix are added to each symbol. The resulting extended symbol is typically windowed using a Nyquist window (or some other common window) wherein the roll off is selected such that all of the prefix and postfix are windowed, but the original symbol is left unchanged. Adjacent symbols are then overlapped so that the windowed cyclic prefix of a particular symbol is added to the windowed cyclic postfix of the preceding symbol.

In F. Giannetti, "OFDM Communications Primer", Intellon Corporation, White Paper #0032, March 1999, which is incorporated by reference, the cyclic prefix and postfix are shaped using a raised-cosine window to provide smooth transitions at the band edges in the time domain, which increases the slope of the spectral band edges.

FIG. 4 illustrates overlapping guard intervals (such as shown in J. M. Paez-Borrallo, "Multicarrier vs. Monocarrier Modulation Techniques: An Introduction to OFDM", BWRC

Retreat – Winter 2000, Berkeley Wireless Research Center, Berkeley, CA, Jan. 9-11, 2000, which is incorporated by reference) that may be applied to CI signals. In this case, an extra guard time XGI includes an overlap of a postfix and an extended cyclic prefix CP. Signals in the extra guard time are shaped to smooth transitions between each symbol and the following cyclic prefix. This helps to minimize adjacent channel interference.

A guard interval may be added to a superposition of CI subcarriers. Alternatively, a guard interval may be provided to each of a plurality of superposition signals produced from subsets of CI subcarriers corresponding to one or more users. In some cases, a guard interval or cyclic prefix may be generated and applied to each individual subcarrier, as is well known in the art and described in A. Czylwik, "Comparison between adaptive OFDM and single carrier modulation with frequency domain equalization", [[VTC]] *IEEE Vehicular Technology Conference*, pp. 865-869, Phoenix, AZ, May 1997, and J. Tubbax, et. al., "OFDM versus Single Carrier with Cyclic Prefix: a system-based comparison," Proc. of IEEE Vehicular Technology Conference [[Fall]], Vol 2, pp. 1115-1119, October 2001, which are hereby incorporated by reference.

Please replace the paragraph beginning at page 22, line 11 with the following rewritten paragraph:

An equalization technique may employ a Wiener least squares filter that utilizes a modified inverse filter to control the white noise response of the filter, i.e. the undesired enhancement of thermal noise from the antenna. In M. Haardt, "Smart Antennas for Third Generation Mobile Radio Systems", Sixth Annual Workshop on Smart Antennas in Wireless Communications, Stanford University, Palo Alto, CA, ~~Stanford Colloquium on Smart Antennas~~, July 1999, which is incorporated by reference, channel equalization is described in terms of a Wiener filtering response. Channel equalization in the context of the Wiener filter is presented in

H. Sari et[[.]] al., "Transmission Techniques for Digital TV Broadcasting", _IEEE Communications Magazine_, Vol. 33, No. 2, pp. 100-109, ~~IEEE communications magazine 33(2)~~ February 1995, which is incorporated by reference.

Please replace the paragraph beginning at page 28, line 10 with the following rewritten paragraph:

In step 534, the resulting time-domain signal is examined to determine if any clipping has occurred (or will occur). If clipping occurs, a new estimate for the clip-prevention signal is generated 535. The new nonlinear clipping function is applied to the data. In some cases, the clip-prevention signal is applied to the IDFT with the data. The time-domain clip prevention signal may be combined with the time-domain signal generated from an IDFT of the data. If there is no clipping, the most recent trial value of the clip-prevention signal is maintained and is transmitted in the unloaded channels along with the DMT-modulated payload 536.

Please replace the paragraph beginning at page 36, line 15 with the following rewritten paragraph:

A sub-carrier generator 302 is adapted to map each of the N symbols S_n onto a plurality of carriers that typically equals N. The number of carriers may be greater or less than the number N of symbols S_n. The sub-carrier generator 302 may include an IDFT, an IFFT, a pulse generator, or any other suitable form of sub-carrier generator, e.g., 302.1 to 302.N.

Please replace the paragraph beginning at page 37, line 16 with the following rewritten paragraph:

FIG. 10B illustrates an embodiment of a CI symbol generator 301. Input data symbols [[dk]] d_k are mapped 308 to symbol constellations $\tilde{d}_k$, prior to a CI code transform module 309. . The symbol mapping module 308 may provide channel coding, code division multiple access,

and/or spread-spectrum coding. The CI code transform module 309 can implement orthogonal basis functions of any invertible transform and provide for any appropriate fast transforms. Similarly, a receiver employing CI decoding may implement a fast transform.

Please replace the paragraph beginning at page 40, line 7 with the following rewritten paragraph:

Multiple users can simultaneously transmit data over the channel 99. The transmitters 1202 and receivers [[1204]] (not shown) can be fixed or mobile subscriber units and/or base stations. The transmitters 1202 and receivers (not shown) can include suitable combinations of hardware and/or software components for implementing the modulation scheme of the present invention. As shown, the transmitter 1202 illustrated in FIG. 12 includes a symbol-to-time mapping module 1204, a pulse filter 1206 supported by a plurality of sub-modules (such as a pulse-train generator 1205, a CI code generator 1203, and a carrier selector 1201) a cyclic extension device 1210, an optional pulse-shaping filter 1212, and a transmitter module 1214.

Please replace the two paragraphs beginning at page 43, line 24 (and continuing onto page 44) with the following two rewritten paragraphs:

The received signal is down converted to a complex baseband signal, filtered (image rejection, adjacent channel rejection, avoid aliasing), and digitized by the RF circuit 1402. The baseband signal may be baseband filtered, such as by a filter 1404 matched to the transmit pulse-shaping filter. The cyclic prefix remover 1406 removes any cyclic extension or guard interval. The frequency domain equalization module 1408 equalizes the received signals for each user's (corresponding to the number of user signals the receiver is adapted to process) channel response. As each user is allocated a unique set of orthogonal subcarriers (due to the modulation codes), all users can be equalized simultaneously in the frequency domain using only one N-

point transform. However, the equalizer coefficients are different for each user and are applied only to the sub-carriers occupied by that user. Thus the equalizer [[408]] 1408 may perform a combination of common processing and user-specific processing. Alternatively the equalization can be based on other techniques such as linear transversal time-domain equalization, decision feedback equalization, maximum likelihood sequence estimation, iterative equalization, inter-symbol-interference (ISI) cancellation, and/or turbo equalization.

For each user, the equalized signal is then code correlated by the CI decoder 1410. Channel decoding, such as Forward Error Correction (FEC) decoding may be provided if error correction coding was used in the transmitter. A decision device [[1414]] 1412 may be adapted to perform a logic decision based on the estimated symbols to determine the values of the symbols.